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ABSTRACT

This paper focuses on a short term plan for a computerized multimedia expert system in the field of the classics that is under development at the University of California at Los Angeles. Noting both increased enrollments in classics courses and the problems associated with finding textbooks for courses in ancient civilizations that cover a variety of subjects, the paper describes the creation of a flexible three-part framework of software: (1) a core of multimedia databases; (2) an inner ring of scholarly utilities for using and modifying the databases; and (3) an outer ring of pedagogical applications, which use the scholarly utilities and databases. A sample lesson--an exploration of the city of Rome with a friendly student interface called "Cicero"--shows how the outer ring will be used in computer assisted instruction for students of classical civilization and Latin. A figure illustrates the organization of the software framework. (EW)

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Cicero

A Framework for Multimedia Projects for Classics

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Background

Thanks largely to the efforts of Theodore Brunner of U.C. Irvine, Classics is now one of the most computerized fields in the humanities. Since 1972, Professor Brunner has overseen the Thesaurus Linguae Graecae, a project to digitize all surviving Greek literature from Homer to 600 A.D. The work is largely complete, and a computerized corpus of some 2,900 authors and 50 million words has been released to the scholarly public.[1]

To date, use of this immense data base has been limited to string searches, which may be either global or limited to a subset of texts and authors. Two different systems have been developed to perform these searches on minicomputers. The first, called IBYCUS, was developed by David Packard in the 1970s to run on Hewlett-Packard equipment. The second, created from 1982 to 1984 by Gregory Crane at Harvard, can be used on any computer that runs UNIX.

In typical configurations of the Harvard system—such as the one David Blank and I designed for use at UCLA and the Getty Center for the History of Art and the Humanities—Macintosh computers are used as smart terminals linked to a VAX 750 or 780 by modems and asynchronous line drivers. In the last few months, both the Packard and Crane systems have been experimentally ported to microcomputers with optical disk drives in order to exploit the reformatting of the data base onto CD-ROM. Meanwhile, a project creating a data base for Latin has been started this year at Yale University under the direction of George Goold.

[1]See L. Berkowitz and K.A. Squitier, *Thesaurus Linguae Graecae. Canon of Greek Authors and Works*, second edition (Oxford 1986) xi–xii.

Multimedia Projects and Fifth-Generation Computer Systems

Strengths and Weaknesses of Existing Classics Software

The capabilities of the Packard and Crane systems are truly astonishing. Within a few seconds, one can search the entire works of an author or even of Greek literature to find every instance of a certain string; and one can telephone from home and read any text in the entire library of Greek literature. This ability has helped researchers to do things never before possible. For example, the concordance (an alphabetical listing of every word in a text with one line of context) is now a virtually defunct genre of Greek scholarship.

On the other hand, as a scholar and educator, I must confess that, for a variety of reasons, I am dissatisfied with existing computer applications for my field. First, there are no instructional uses of the data base, for the simple reason that current software presumes a fairly high level of fluency in ancient Greek. Second, the available search programs leave much to be desired, both in their user friendliness and in their power to manage and manipulate the data base. Boolean operators are not yet available, nor have the resources of the Macintosh been tapped to any degree. Finally, the preoccupation with string searching, while understandable, has given many classicists the mistaken impression that the primary use of the data base is as an electronic library or concordance. There are many other potential uses for this wonderful data base.

UCLA's Plans for New Classics Computer Applications

At UCLA, we have been encouraged by the central administration during the past academic year to develop a three-year plan for use of the computer in research and instruction. In our department, we began by envisioning an ideal multimedia expert system for Greek, Latin, and Classical Civilization. We proceeded on the assumption that our vision could be realized in the next ten to fifteen years, when fifth-generation computer systems[2] and massive textual and visual data bases will have been created and made commercially available. Our three-year plan was thus understood to be a step in the direction of a definable goal.

[2]See T. Moto-Oka (ed.), *Fifth Generation Computer Systems. Proceedings of the International Conference on Fifth Generation Computer Systems, Tokyo, Japan*, October 19–22, 1981 (Amsterdam, New York, Oxford 1982).

The Basis of Planning: A Vision of the Year 2000

Before describing our short-term plan (the focus of this paper), let me sketch my vision of where we will be in 10 or 15 years. By that time, we should have created a Classics Expert System that will serve everyone from the beginning student to the most advanced scholar. At the heart of this system will be vast visual and textual data bases of the primary materials of the field—manuscripts[3], inscriptions, archaeological sites, art, architecture, and other artifacts—as well as the major reference works and about 25 percent of the secondary literature that is used 80 to 90 percent of the time[4]. Communication with the system will be almost entirely by voice.

Voice recognition and synthesis and the natural-language processing of Greek and Latin will have progressed far enough to permit computer-managed instruction in the ancient languages, starting from the elementary level. Machine translation[5] will permit students of Classical Civilization—that is, those who study antiquity through English translations—to access the same textual data base used by students and scholars of Greek and Latin. Instruction and research will emphasize interdisciplinary approaches, since much of the expertise of the ancillary specialties of the field will have been incorporated into the expert system.

[3]The Thesaurus Linguae Graecae project gives us ancient Greek literature through modern scholarly editions; the ideal Classics Expert System will include a data base of the actual manuscripts and papyri on which the modern editions are based, along with a collation program for automatically representing the ancient, medieval, and modern evidence for the text.

[4]Using a library data base program such as UCLA's ORION, it should be easy to determine the most frequently consulted books and journals within a certain range of call numbers. It is my undocumented suspicion that a very small percentage of books accounts for a very high percentage of what readers actually use in a field.

[5]See H. Tanaka, et al., "Intelligent Man-Machine Interface," in T. Moto-Oka, op.cit, 147–155.

For instruction, this means that learning will take place in environments in which a linguistic signifier is encountered with immediate visualization of—and, when possible, dramatized interaction with—the corresponding referent. For scholarship, this means that quantification and statistical analy will become increasingly important, as will the methodologies of economics psychology, and sociology, which facilitate the analysis of cultural artifacts different periods, proveniences, and types. In this ideal world, students will learn faster and better, and for the first time in centuries[6], will even be able speak Greek and Latin. Scholars will be freed from much, if not all, of the drudgery presently involved in data collection, and will have more time to develop and discipline their informed historical imaginations. The advent o the Classics Expert System will thus make this central field of the humaniti less mechanical—more accessible and vital.

[6]This feature of CALI (Computer-Assisted Language Instruction) in Latin and Greek cannot be overemphasized, since it will enable classicists to benefit from "modern language" techniques of interactive oral instruction. Then, while CAI has been found to have only modest effectiveness in general (see J.A. Kulik, C.-L.C. Kulik, P.A. Cohen, "Effectiveness of Computer-based College Teaching: A Meta-analysis of Findings," *Review of Educational Research* 50 (1980) 525–544; K. Ahmad, et al., op.cit., 119–122), it is reasonable to expect that CAI will have a high level of effectiveness in Greek and Latin instruction. Significantly increased effectiveness via videodisc-based instruction is reported by A.M. Abdulla, L.O. Watkins, and J.S. Henke, "The Use of Natural Language Entry and Laser Videodisk Technology in CAI," *Journal of Medical Education* 59 (1984) 739–745. The advantages of the videodisc for foreign language instruction are discussed by S.E.K. Otto, "Videodisk Image Retrieval for Language Teaching," *System* 11 (1983) 47–52.

Multimedia Projects for the Next Three Years and the Educational Needs They Address

Our goal in the next three years is to take some small but important steps toward the Classics Expert System, by showing that a multimedia computer system can be built today that will help solve pressing problems confronting us in teaching Greek, Latin, and Ancient Civilization to our students.

Immediate Problems to be Addressed:
Booming Enrollment, Stable Faculty Size

What are these problems? First, there are the welcome problems stemming from soaring enrollment in Classics. The following table shows the steady growth in the number of undergraduate and graduate enrollments in Classics at UCLA from 1977–78 to 1985–86:

Table: Total UCLA Classics Enrollment, 1977–1986

Year	Enrollment
1977–78	1,117
1979–80	1,278
1981–82	1,489
1983–84	1,547
1984–85	2,181
1985–86	2,995

Some of the factors responsible for this trend are local: for example, the number of undergraduates at UCLA grew by nearly 10 percent during this period; and in the fall of 1983, the Classics department initiated a new major in Classical Civilization, in which the study of Greek and Latin is recommended but not required. Local factors cannot, however, explain the entire rise, since many colleagues around the country report similar trends at their institutions.

Perhaps the most pressing problem caused by the near trebling of enrollment at UCLA during the past 10 years results from the simple fact that our faculty size has remained constant. Thus, our student/faculty ratio has worsened, and we need to find some remedy other than increasing the size of the faculty to ensure that we can maintain the quality of our instruction.

This problem is especially noticeable in the large lecture courses on Greek and Roman civilization that satisfy "general education" requirements at UCLA. In these courses—often the student's only exposure to the humanities in college—the average enrollment has grown from about 100 to more than 400 in the past ten years. As a result, education has become quite impersonal for both instructor and student, and the humanities have had to be presented in a nonhumanistic way. Opportunities for class discussion have diminished, as have the odds that a student will ever visit the professor during office hours to pursue discussion of some topic that aroused the student's curiosity. Multiple-choice examinations have become more frequent and have, indeed, all but replaced essays and research papers as the basis of grading.

Curricular Problems

The second set of problems we need to address is curricular. I suppose that one reason Classics is booming across the country is that it is a field that was able to attract many bright new assistant professors during the past 20 years, even during the depressed academic job market of the 1970s. These new faculty recruits brought vitality and energy to the field. Now entering their most productive years as teachers and scholars, many professors in this generation have been great believers in interdisciplinary approaches to Classics. As such, they have faced great frustrations in operating within a curriculum that is unidisciplinary at most universities, and they have been thwarted in their attempts to infuse even traditional courses with interdisciplinary perspectives by the absence of suitable textbooks.

For example, I teach a course called Roman Civilization to about 400 students each year. Although there are acceptable texts for political and military history, customs, and the arts, there is no single text that adequately synthesizes these major facets of the civilization, relating developments in one area of the culture to what is happening in other areas. In the courses in which Greek and Latin literature is read in the original, the situation is still worse: the older commentaries are going out of print faster than new ones are being published to replace them, and only rarely do these commentaries—old or new—treat nonlinguistic or nonliterary matters.

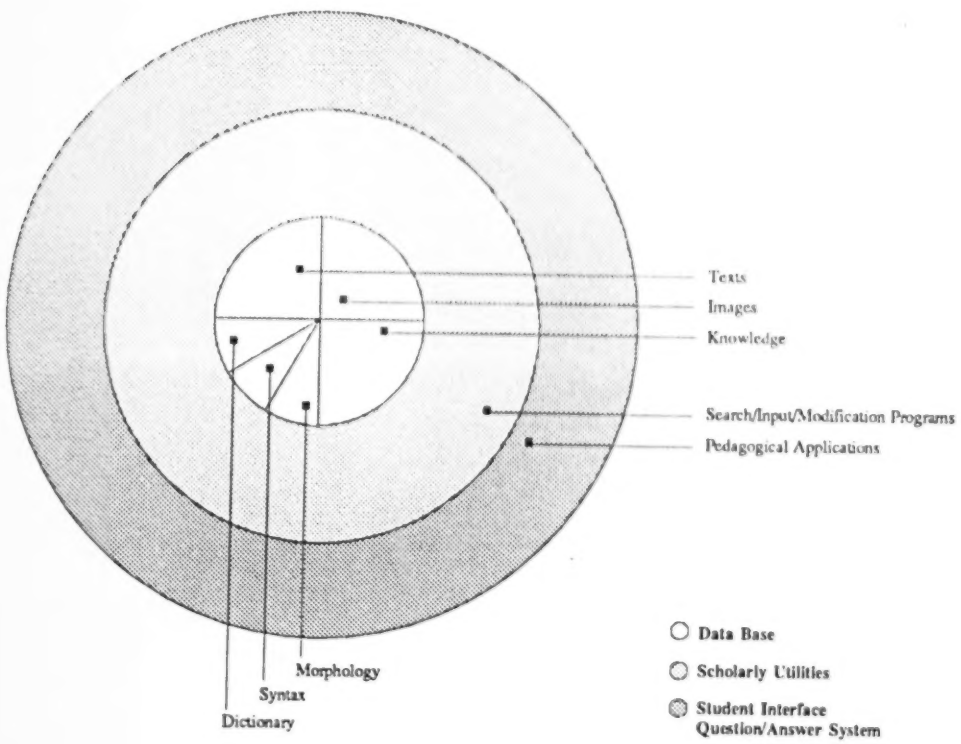
Traditional humanistic education is quite labor-intensive. Ideally, students study individually or in very small groups with senior tutors. If this approach were ever appropriate and feasible in a large American research university, it isn't any longer. Although our enrollment has trebled, I would be pleasantly surprised if our faculty is allowed to grow by more than 15 percent (the equivalent of two new faculty positions) in the next few years. Some other solution to the problem of our worsening faculty/student ratio is needed.

We think that a major component of any solution has to involve greater use of the computer in instruction. We also think that the computer, used creatively, can help solve many of the curricular problems we face. Since both kinds of problems are most acute in our civilization courses, it is there—specifically in Roman Civilization—that we propose to begin implementing our multimedia computer project. We will also be trying to apply the same approach to our intermediate Latin courses, in which enrollments have also been considerably higher in recent years.

Multimedia Solutions: Data Bases, Utilities, Applications

The great challenge during the next three years is to create a flexible framework for software design that will last through years of innovation in technology and educational theory. The framework that we have developed for our project has three parts: a core of multimedia data bases; around the core, an inner ring of scholarly utilities for using and modifying the data bases; and an outer ring of pedagogical applications, which use the scholarly utilities and the data bases.

The nature of the core and inner ring is fairly clear and requires more funding than imagination to create. The core includes data bases for Greek and Latin texts, morphologies, dictionaries, and syntax; images of archaeological artifacts of all kinds, from coins and lamps to statues and buildings; and an encyclopedia and bibliography.[7] The inner ring includes search programs with Boolean operators for data collection from the data bases; and parsers for morphology, syntax, rhetoric, and meter. The character of the outer ring—the interface with the student on all levels—has taken over a year to sketch out through the collaboration of subject experts and specialists in instructional-media development. I will summarize our plans for the student interface in a moment, after a word about our pedagogical assumptions.



[7]Many of these data bases are already being created; for example, the American Philological Association is digitizing the standard Classics bibliographical annual; the J.Paul Getty Museum is creating a videodisc for Greek iconography; and our department is digitizing the Greek-English lexicon.

Pedagogical Theory: Curiosity Arousal

Whereas the structure of the core and inner ring reflect that of the field of Classics itself, that of the outer ring must be dependent both on this field and on a theory of knowledge acquisition. The theory I have devised is a hybrid based on the key notions of student involvement in learning[8] and the arousal of the student's curiosity.[9] The theory of interaction holds that students learn best when they become actively involved in their own education; the theory of curiosity (or "effectance") arousal explains how we become motivated to learn in proportion to the confusion and challenge we experience in a new environment. Russ, Gold, and Stone have recently shown that when students are exposed to extremely foreign material and asked to learn it, they tend to turn for help to "dissimilar others," that is, "experts" perceived to be more oriented to the new knowledge than were the students themselves. Russ and his colleagues have also shown that this kind of experience significantly increases student curiosity.[10]

It seems to me that these two theories of learning are complementary—one stresses the need for the student to be curious, the other tells us how to make people curious.

[8]The importance of active student involvement in learning has been emphasized in two recent reports on American education; see M.J. Adler, *The Paideia Program* (New York 1984), especially pp.167–179; and Involvement in Learning (National Institute of Education, October 1984), especially pp.17–19. On strategies for increasing student involvement, see V. Roadrangka and R.H. Yeany, "A Study of the Relationship among Type and Quality of Implementation of Science Teaching Strategy, Student Formal Reasoning Ability, and Student Engagement," *Journal of Research in Science Teaching* 22 (1985) 743–60.

[9]See R.W. White, "Motivation Reconsidered: The Concept of Competence," *Psychological Review* 66 (1959) 297–333; R.C. Russ, J.A. Gold, and W.F. Stone, "Attraction to a Dissimilar Stranger as a Function of Level of Effectance Arousal," *Journal of Experimental Social Psychology* 15 (1979) 481–91.

[10]Ibid., 489

How can the computer help us implement these two theories? One of the potential strengths of CAI is its highly interactive nature—however rare interactivity may be in existing courseware.[11] As for curiosity arousal, the computer with multimedia programming is an ideal tool for creating an imaginary world that is at the same time challenging and intriguing to the student, and for providing the student with a friendly guide (a "dissimilar other") for successfully navigating through that world. This guide I will call "Cicero," after the Italian word (*cicerone*) for a tour guide.[12]

Cicero: The Student Interface

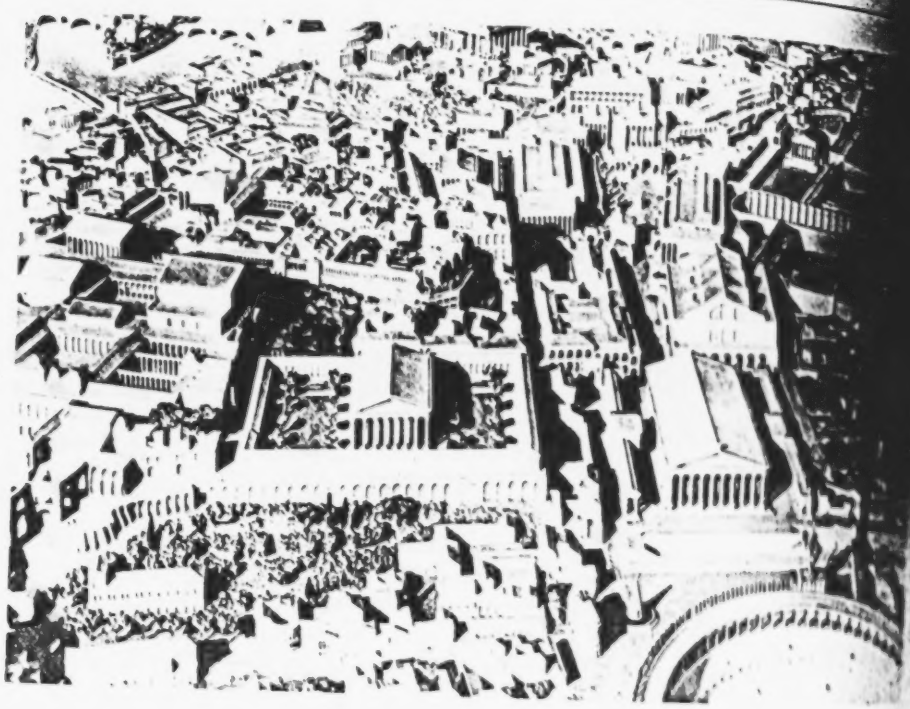
With this background, I can now describe our proposed structure for the outer shell, the student interface for Roman Civilization and Intermediate Latin.

In the Museo della Civilita' Romana in Rome, there is a model of the city at its height of development in 315 A.D., when the population had reached about 1 million and the urban fabric covered some 30 square kilometers. The model is extremely accurate because our archaeological knowledge of the city is quite precise, and we even have an enormous ancient map of the ground plan of every building in the year 211 A.D. at a scale of 1:250. Added to this visual material are hundreds of pages of literary and epigraphical sources, making Rome the best-documented city from antiquity. The model in the museum is itself quite impressive—it is over 60 feet in diameter and reflects the state of the scholarship in Roman topography.

[11] See K. Ahmad, et al., *Computers, Language Learning and Language Teaching* (Cambridge1985) passim, especially p.4: "the computer can offer interactive learning. This means that it can conduct a two-way learning session with the student. It is much more than a mere programmed textbook, whose powers of interaction are virtually limited to an ability to reveal the correct answer: the computer can 'assess' the student's response. It can also display messages, take the student through subsequent attempts at a question, and even take the student to a different section of the package, depending on the nature of the response. The computer can do all this very quickly—its response is practically instantaneous. If the computer is impersonal and literal-minded, it is also unfailingly accurate and precise. It does not tire, and its attention does not falter. It can repeat an activity with none of the errors which easily arise from repetition by humans, and it is as impartial and unbiased as the linguistic material which is typed into it. It can handle a very large volume of interaction and can deliver to the student feedback of some subtlety, at more frequent intervals than would be possible for a human teacher in all but individual tuition sessions. And it is flexible in a number of significant ways...." On the importance of eliciting student interaction in language learning, see J.H. Schumann, "Second Language Acquisition: The Pidginization Hypothesis," *Language Learning* 26,2 (1976) 391–408, at p.403.

[12] "Cicero" is also the name of a CAI authoring system used at the Open University in Great Britain; see A. Jones and T. O'Shea, "Barriers to the Use of Computer Assisted Learning," *British Journal of Educational Technology* 13 (1982) 207–217, at p.207.

Figure 1:
Detail of the city center in the model of ancient Rome.



Classics is the study of every aspect of ancient civilization, including literature, religion, art, science, and even clothing and footwear. What better way to study Classics than by returning to a cultural center like Rome, learning about the city and its civilization, and discovering how to survive with the help of a friendly guide? We intend to use techniques of macrophotography developed for contemporary city planning by Donald Appleyard of U.C. Berkeley to photograph the model of Rome at street level. We will transfer thousands of photos of the model to a videodisc or CD-ROM, thereby enabling us to simulate visits to the city at the high point of its development.[13] There, students of Classical Civilization and of Latin will take guided tours emphasizing different aspects of the culture, such as religion, economics, or politics. On each tour, the student will be able to print the screen, thereby collecting evidence, visual ("snapshots") or literary ("quotations"), to be used as documentation for an essay.

Cicero: A Sample Session

For example, in the lesson on entertainment, students will be asked to plan their weekly tours through the city to investigate the varieties of public entertainment and recreation available to the average citizen. The student will also be asked to study one type of entertainment or recreation (for example, parks, baths, or theater) in some detail.

[13]For a comparable (if much more modest) project, cf. the "Montevidisco" CALI package for students of Spanish, as described by E.W. Schneider and J.L. Bennion, "Veni, vidi, vici via videodisc: A Simulator for Instructional Conversations," *System* 11 (1983) 41–46.

In a sample session, a student would log in, select the tour of the week, and find displayed on the screen the twenty or so places in the city related in some way to entertainment. The student would be asked to explore at least five of the places and then to link them by some original observation or idea in an essay. As the student moves into the model at street level to approach the first place, he or she will find various resources that will be helpful on the tour: a group of guides (personified along the borders of the screen by actual polychrome portraits from the Roman period and given names by which they may be invoked), a glossary of technical terms, a bibliography with leads for further research in the University Research Library, and a small reference library, including key ancient and modern texts about the sites.

The student might begin with very little idea of how to approach the assignment. He or she might therefore consult a guide, asking for advice on how to proceed. The guide will teach socratically whenever possible, answering a question with a question, in order to force students to think through their problems themselves.

A student choosing to study the theater might notice and comment on the concentration of the three main theaters (Pompey's, Marcellus's, and Balbus's) in a "theater district" in the western Campus Martius; or the dedication of the theaters to famous politicians; or the freestanding design of the structures, differentiating them from their Greek prototypes, which were generally built into hillsides; or the presence of large public peristyles behind the stage.

Wondering why one theater (Pompey's) has a temple atop the seating section, the student would search for an explanation. He or she might, for example, consult the technical glossary on "theaters" under "building types," and there would note that temples are not, in fact, common enough appendages to be listed and illustrated in the axonometric drawing of the typical Greek and Roman theater. The student might then look for a particular historical explanation, perhaps by requesting biographical information about Pompey from the reference library. There he or she would find the famous story about how Pompey could build Rome's first permanent theater only by pretending to be erecting a temple with a large "staircase" in front.

The student might then look in the bibiliography for an entry such as "theater-temples" and there would find a reference to J.A Hansen's monograph on the subject,[14] which he or she might then consult in the University Research Library. (We consider use of the library crucial, by the way, if the system is to be an aid to the students' intellectual development and not a crutch, since students still need to be prepared to function in a world in which the printed book will continue, for quite some time, to be the dominant medium.) The point of the weekly essay might well be to note features in common to all the theaters in the city of Rome (location, peristyle, dedication to a political figure) and to explain why Pompey's theater differs in one important respect (by having a temple to Venus grafted onto it).

[14] *Roman Theater-temples, Princeton Monographs in Art and Archaeology* 33 (Princeton 1959).

Cicero: Other Uses and Future Enhancements

Equally exciting is the prospect of adapting Cicero to our Intermediate Lat
(and perhaps Greek) sequence. The main purpose of the sequence is to rev
basic grammar and vocabulary while teaching students how to read such
authors as Virgil, Plautus, Cicero, and Caesar. Since the literature in the
reference library is, of course, written in Greek and Latin, we will have our
language students read in the original these sources for the topography and
history of the city. By supplying such utilities as a morphological and
syntactic parser, a dictionary, and a rudimentary commentary, we should be
able to let Cicero totally replace the traditional schoolboy commentaries use
this level. And right from the first moment they can read Latin or Greek,
students will be involved in the kind of exciting research projects that have
customarily been reserved for graduate students. The tedium of in-class
recitation and translation will be replaced by students' reports on what they
have learned while wandering through Rome investigating the weekly topic.

Conclusion

The advantages of using the city itself as the framework for the student interface in these civilization and language courses should be clear: like the field of Classics, the city contains all of ancient life, and so all aspects of the study of Classics naturally arise during a visit to Rome. Secondly, the city—and the model of the city—is vast and impressive, fascinating and foreign enough to arouse the students' curiosity, filled with helpful guides who are ready to help students experience the challenges of everyday life in a foreign environment. Thus, through the simulation afforded by the videodisc, computer-assisted language instruction can move beyond the structuralist approach used all too often in the past and can be based on the concept of communicative interaction.[15] Moreover, the setting of individualized instruction at a computerized multimedia workstation allows for the development of the students' intrinsic motivation and minimizes extrinsic (and often counterproductive) motivators such as grading.[16] The weekly writing assignment will replace objective testing or translation, and will add an important dimension to the students' educational experience in the course.

Finally, this project should help us solve our department's major problems. Cicero provides a powerful tool for increasing faculty productivity and for providing the student with the kind of experience hitherto possible only to the handful of students who could afford a tutor and an extended stay in Rome. Cicero creates a multimedia and interdisciplinary environment for learning. And, Cicero enhances students' involvement in learning by placing them in a fascinating simulated world in which their curiosity and creativity can blossom and flourish. The city is as infinitely rich as life itself. As such, it offers us a comprehensive framework for integrating new scholarly discoveries and methodologies, as well as innovations in hardware and software. Moreover, if our pilot projects are successful, the city can continue to set the scene for many of our other language and civilization courses by a simple expansion of the various multimedia data bases.

[15] See D. Sanders and R. Kenner, "Whither CAI? The Need for Communicative Courseware," *System* 11 (1983) 33–39, especially pp. 34–36, stressing the need for graphics and games. On the communicative, as opposed to structural, approach to language learning, see T.D. Terrell, "A Natural Approach to Second Language Acquisition and Learning," *The Modern Language Journal* 41 (1977).

[16] On intrinsic motivation, see E.L. Deci, *Intrinsic Motivation* (New York 1975); on the theory that challenging tasks are preferred to simple ones, see S. Harter, "Effectance Motivation Reconsidered," *Human Development* 21 (1978) 34–64.

Bernard Frischer

Bernard Frischer received his B.A. in Classics fro Wesleyan University in 1971. He entered the Ph.D. program in Classics at the University of Heidelberg, wrote his dissertation on a new theor of literary hermeneutics applied to Virgil's pasto poetry, and received his doctorate in 1975. As a Rome Prize Fellow in Classics at the American Academy in Rome, he expanded his horizons to include Roman art, archaeology, and topography. Since 1976, he has been teaching classics at UCLA, for the past two years, he has been chairman of the Classics Department. Dr. Frischer's last book, The Sculpted Word, *is about how the Epicurean school recruited new students by using sculpted portraits of their leaders as publicity. Currently, he is writing a book about how Horace's* Art of Poetry *parodies neoclassicism in the arts during the Augustan Age. In 1982, Dr. Frischer bought his first personal computer. He sees the commercialization of the personal computer in the 1980s and the development of multimedia technologies as a great boon for those who believe in studying mankind from integrated, interdisciplinary perspectives.*

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